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September 18, 1967

Orville F. Keller
Jet Propulsion Laboratory
California Institute of Technology
Liquid Propulsion Section
4800 Oak Grove Drive
Pasadena, California 91103

Dear Orville:

This letter covers the first month of activities on the program, "Radiation Effects on Liquid Propellants", which is concerned with determining the present state of knowledge with respect to the effects of high energy radiation on various liquid propellants.

Work This Period

During the first month of this program work was initiated on two phases of the study; to gather all pertinent information relating to radiation effects on various fuels and oxidizers comprising possible liquid propellant systems, and to define the nature and intensity of possible radiation fields from on-board radioisotope or reactor power supplies.

The literature search on radiation effects is almost complete. This has been accomplished using the facilities of the REIC (Radiation Effects Information Center) as a primary source of radiation effects data. The search has included the seventeen compounds and combinations as agreed upon. A secondary search is being made of such sources as Chemical Abstracts to obtain information on chemical and physical properties, photochemical reactions, etc. of the designated compounds.

Contracts have been made with research groups at Marshall SFC and Lewis Research Center in an attempt to identify work in progress related to this task. However, these contacts have yielded little directly useful information as yet.

In the second phase of this study a selection was made of four radioisotopic heat sources which will be further investigated with respect to their radiation characteristics. These sources (shown in Table 1)

were selected after careful consideration of their respective half-lives, types of radiation emitted and corresponding shielding requirements. In cases where more than one compound of a given radioisotope were available (e.g., SrO and $SrTiO_3$) the most prevalent compound was chosen as being typical.

Radiation data for all of the sources shown in Table 1 have been collected from various references and are being compiled for subsequent parametric presentation. Typical data include; isotopic composition (including impurities), types and intensities of radiation emitted, and also the radiation spectra of all emissions.

TABLE 1. CHARACTERISTICS OF RADIOISOTOPIC HEAT SOURCES

Isotope	^{60}Co	^{90}Sr	^{238}Pu	^{244}Cm
Half-life, Years	5.3	27.7	86	18
Compound Form	Metal	$SrTiO_3$	PuO_2	Cm_2O_3
Type of Radiation* (Major)	$\gamma\beta$	βx	αn**	αn

* α Alpha, β Beta, γ Gamma, n Neutron, x Bremsstrahlung
** From (α,n) reaction

Work Next Period

During the next report period efforts will continue to establish contacts with research groups engaged in studies pertinent to this program so that our data on radiation effects will be, as much as possible, complete and up to date. Also we will continue to compile the data on radioisotope source materials collected thus far and to identify radiation from impurities which varies with time. Also, a parametric study will be initiated of radiation flux as a function of time, separation distance and power level for the various radioisotope sources.

Approximately 17 percent of the time alloted for this program has elapsed and expenditures to date are approximately $3,700.

If you have any questions or comments regarding this report, please call me.

Very truly yours,

John F. Kircher
Chemical Physics Research

JFK:ahp